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(71) Applicant : **HALLIBURTON COMPANY**
P.O. Drawer 1431
Duncan Oklahoma 73536 (US)

(72) Inventor : **Burns, Timothy D., Sr.**
Route 4, Box 243C
Duncan, Oklahoma 73533 (US)
Inventor : **Caskey, Kenneth D.**
2937 Clayton Avenue
Duncan, Oklahoma 73533 (US)

(74) Representative : **Wain, Christopher Paul et al**
A.A. THORNTON & CO. Northumberland House 303-306 High Holborn
London WC1V 7LE (GB)

(54) Downhole tool retrieving apparatus.

(57) Apparatus for use on a non-rigid workstring for retrieving a downhole tool, comprising a jar (204) ; a swivel (202) threadedly connected to said jar (204) ; a safety release sub (200) threadedly connected to said swivel (202), containing at least one shear pin ; a power mandrel (100) threadedly connected to said safety release sub ; means (128,140,129,132,142,134,136), adapted to said power mandrel (100), for latching said apparatus to said downhole tool ; and overshot means (152) cooperating with said power mandrel, for guiding said apparatus over said downhole tool.

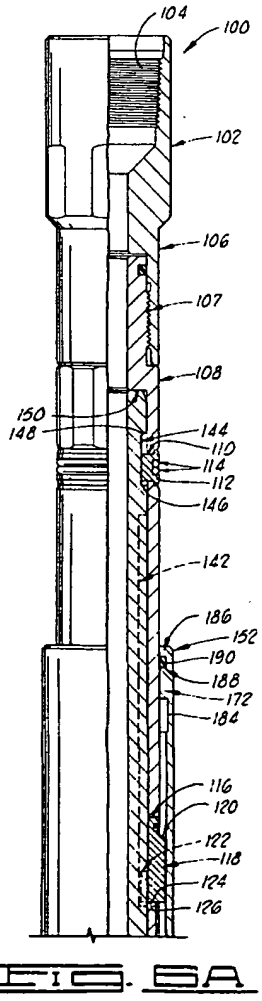

FIG. 6A

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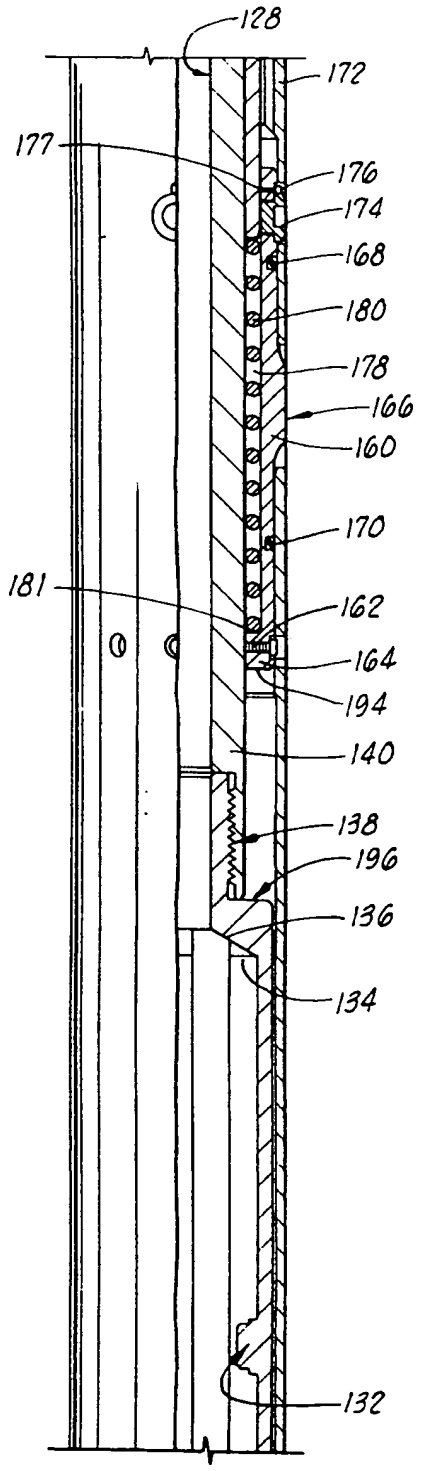
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FIG. 6B

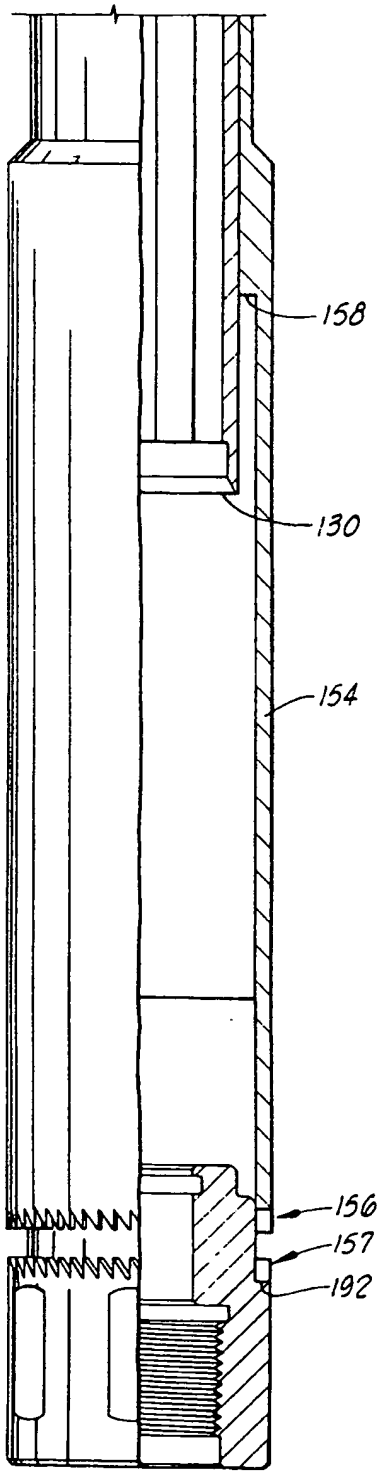
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FIG. 6C

This invention relates to an apparatus for use on a non-rigid workstring for retrieving downhole devices in a wellbore. More particularly, but not by way of limitation, the invention is of especial use on a workstring which does not provide for rotational movement, eg. a workstring of coiled tubing, wireline, or electric line.

Wireline set, tubing retrievable packer type bridge plugs are known in the art. In oil and gas wells, it is desirable to have a bridge plug which will withstand high differential fluid pressures thereacross. In the past, these bridge plugs have been set utilizing either wireline or drill pipe workstrings. Examples of these wireline set tubing retrievable bridge plugs are found in our U.S. patent specification nos. 4,648,446 to Fore and Caskey, and 4,693,309 to Caskey.

As can be seen from these patents, the apparatus used to retrieve these packers comprises an overshot member, upper ring spring holder, lower ring spring holder, and ring spring. Furthermore, to retrieve the bridge plug in the prior art, the retrieving tool previously discussed is connected to a tubing string and lowered into the casing wellbore. A description of the procedure used to retrieve the prior art bridge plug can be found in U.S. Patent 4,648,446, column 7, beginning at line 53, and continuing through column 9 line l0.

However, oil and gas operations are increasingly relying on either coiled tubing, wireline or electric line service to perform work previously done by drill pipe or production tubing. One of the reasons for increased reliance on coil tubing, electric line, and wireline is the lower cost and greater ease of operation utilizing these methods. Also, horizontal wells are being drilled increasingly, and traditional "rigid" workstrings such as drill pipe have certain limitations, as will be understood and appreciated by those skilled in the art. However, the prior art does not provide for the retrieving of the bridge plugs or other downhole apparatus except by utilizing a rigid workstring in which rotation can be imported from the surface to the downhole tool.

We have now devised a retrieving tool which does not require a rigid tool string. Instead, the tool of the invention can be run in the hole utilizing an apparatus such as coiled tubing, electric line, or wireline. The actual downhole bridge plug or other downhole device to be retrieved is modified only to include reciprocal ratchet teeth at its upper fishing neck, otherwise the downhole packer or other downhole device remains unchanged.

According to the present invention, there is provided apparatus for use on a non-rigid workstring for retrieving a downhole tool, comprising a jar; a swivel threadedly connected to said jar; a safety release sub threadedly connected to said swivel, containing at least one shear pin; a power mandrel threadedly connected to said safety release sub; means, adapted to said power mandrel, for latching said apparatus to said downhole tool; and overshot means cooperating with said power mandrel, for guiding said apparatus over said downhole tool.

The retrieving tool of the invention utilizes a power mandrel to transmit a longitudinal force downhole. An overshot means is provided to engage the retrieving tool onto the bridge plug. A means for latching on to the top of the bridge plug (or other downhole device) is provided on an inner sleeve mandrel, with the inner sleeve mandrel being slidably disposed within the power mandrel. The inner sleeve mandrel also contains means for rotating the inner sleeve mandrel within the power mandrel.

After attaching the overshot means to the plug, the following means for rotating is utilized. Specifically, the means for rotating contains a J-slot member located on the inner sleeve mandrel. A J-slot lug is provided on the power mandrel. Once a longitudinal force has been applied, by setting down weight from the surface, the lug is moved up and, transversely following the contours of the J-slot member, with the lug causing the J-slot member to rotate. This imparts the rotational movement to the power mandrel via the inner sleeve mandrel.

Next, weight is slacked off from the surface which allows the lug to travel down, but this time at a different reference point in the J-slot member. At this point, the lower lug will also turn in the J-slot member of the plug. Once the appropriate distance has been slacked off, weight will again be picked up. Again the J-slot lug of the power mandrel will travel upward, and transversely following the contours of the J-slot member. This will complete rotational movement of the inner sleeve mandrel relative to the power mandrel and the upward movement will upset the plug.

In a typical operation, first, a closed valve will be placed on-top of the bridge plug. Thus, in order to open the valve, the lower shoulder of the second inner sleeve mandrel will come into contact with a sliding sleeve on the valve. Downward movement of the shoulder (located on the inner sleeve mandrel) will result in opening of the valve because the shoulder pushes the valve's sliding sleeve open. As the valve is being opened, the lug on the second inner sleeve mandrel will be positioned into the J-slot portion contained on the valve means.

Finally, an overshot means is provided to guide and engage the apparatus over the downhole packer. The overshot means provides a lower housing which contains ratchet teeth. The downhole apparatus (which may be an Express Bridge Plug) to be retrieved has been modified to contain receptacle ratchet teeth. Thus, as the overshot comes into contact with the plug, the ratchet teeth will engage. This will prevent counter clockwise rotation of the overshot mandrel, but will not effect the inner sleeve mandrel or the power mandrel's ability to rotate relative to one another.

Therefore, faced with a problem of the inability to

retrieve downhole apparatus such as Express Bridge Plugs when the workstring utilized is coiled tubing, wireline or electric line, the present invention allows the translating of longitudinal movement into rotational movement. One feature of the present invention is having an inner sleeve mandrel slidably disposed within a power mandrel. Defined on the inner sleeve mandrel is a J-slot member wherein upward and downward movement of the power mandrel causes rotational movement of the inner sleeve mandrel. Another feature includes the lower ratchet teeth contained on the overshot means which will engage the upper plug to prevent the overshot from counter clockwise rotation. Yet another feature includes the overshot housing with spring chamber which allows a variable length between the valve opening sleeve and the lower J-slot.

An advantage of the present invention lies in the use of a workstring with a minimal outer diameter i.e. coiled tubing, wireline or electric line. Another advantage flows from the use of a less expensive workstring. Yet another advantage is in the use of a workstring which is compatible for use in highly deviated and horizontal oil and gas wells. Still another advantage relates to the ease of operating a workstring such as coiled tubing, wireline or electric line as compared to rigid workstrings such as drill pipe or production tubing.

In order that the invention may be more fully understood, reference is made to the accompanying drawings, wherein:

Figure I is a quartered sectional view of a typical downhole device such as a bridge plug used in the prior art as disclosed in U.S. patent specification no. 4,693,309.

Figure 2 is a diagram of the typical workstring for use with the present invention.

Figure 3 is an unwrapped view of a portion of embodiment of J-slot member mandrel of the present invention which is used to retrieve a bridge plug.

Figure 4 is an unwrapped view of a portion of the J-slot member configuration in one end of the J-slot mandrel of the prior art bridge plug which is used to release the ratchets during the retrieval of the bridge plug.

Figure 5 is a view of the prior art retrieving tool used to retrieve the bridge plug on a rigid workstring.

Figures 6A-6C are cross-sectional views of an embodiment of retrieving apparatus of the present invention.

In the description which follows, like parts are generally marked throughout the specification and drawing with the same reference numerals, respectively.

Referring to Figure 6A, the retrieving tool comprises generally a power mandrel I00. The power mandrel includes a top adapter I02. The top adapter is defined by a box threaded connection I04. Referring to Figure 2, in the preferred embodiment, the top adapter will be threadedly connected to an emergency release sub 200, with the release sub being threadedly connected to a swivel 202, and finally the swivel being threadedly connected to a jar 204.

Referring again to Figure 6A, the outer diameter of the top adapter I02 defines a recess of smaller outside diameter I06. The bottom portion of the top adapter is a threaded box connection I07, which connects to the lower power mandrel I08, with the lower power mandrel 108 and the top adapter I02 making up the power mandrel 100. The lower power mandrel 108 contains a plurality of slotted grooves 110 about which a plurality of arcuate locking dogs 112 are placed therein. A circular spring lock 114 is placed around the plurality of locking dogs 112, to hold the locking dogs 112 in place.

Also defined on the lower power mandrel 108 is a single slot characterized at 116. Placed within this single slot 116 is a J-slot lug 118. The J-slot lug 118 contains a first shoulder at 120 and second shoulder on the opposite side of lug 118 at 122. The base of the lug 124 rests against the shoulder 126 of the lower power mandrel.

An inner sleeve mandrel 128 in Fig. 6B is slidably disposed within the power mandrel 100. Referring to Figure 6C, the inner sleeve mandrel 128 contains a first shoulder 130 which defines one end of the inner sleeve mandrel. Now referring to Figure 6B, also disposed on the inner sleeve mandrel is J-slot lug 132. The lug 132 is set on the inner sleeve mandrel 128. The bore of the inner diameter of the inner sleeve mandrel decreases relative to the center of the mandrel, forming an obtuse angle 134 at frusto-conical shoulder 136. The neck formed from the obtuse angle defines a threaded pin connection 138. The second portion of the inner sleeve mandrel 140 is threadedly connected to the inner sleeve mandrel at thread connection 138. Referring to Figure 3, the second portion of the inner sleeve mandrel 140 has defined thereon a J-slot member of pattern 142. As previously recited, the lug at 118 is received within J-slot member 142.

Referring now to Figure. 6A, an upper neck, generally at 144, is defined on the outer periphery of the second portion of the inner mandrel 140. A first shoulder 146 is defined on the inner sleeve mandrel 128 wherein the previously described locking dogs 112 rest. A second frusto-conical shoulder, 148, is formed on the upper neck 144, this second frusto-conical shoulder 148 having an obtuse angle to the base of the inner sleeve mandrel 128. A final shoulder 150, which represents one of the inner mandrel 140, abuts the power mandrel 108 and prevents upper longitudinal movement.

The inner sleeve mandrel 128, the upper portion 140 and lower portions 129, the J-slot lugs 132, the J-slot member 142, the recess necks 134 and associated shoulders 136 comprise the means for latching

the retrieving tool to the downhole device.

The overshot means is seen generally at 152. The overshot consists of three primary members 160: outer sleeve 154, ratchet means 156, and center spring housing 166. Referring to Figure 6C, the outer sleeve member 154 has defined thereon ratchet teeth at 156. The ratchet teeth 156 will engage reciprocal ratchet teeth 157 located at the top end of the bottom hole device, generally a bridge plug, as shown in Figure 1.

Referring again to Figure 6C, the inner diameter of the outer sleeve 154 defines a shoulder at 158. The outer sleeve 154 slidably rests about the inner sleeve mandrel 128. Note that Figure 6C does not show the valve 222 of the downhole device (typically, a bridge plug), seen in Figure 1 and depicted generally at 220. Referring to the Figure 6B, the outer sleeve 154 is rigidly-connected to a center spring housing member 160. In the preferred embodiment, the outer sleeve is rigidly fixed to the center spring housing 160 by means of a hex lock screw 162. The center spring housing contains a lower member 164 containing an aperture for entry of the hex hock screw 162. The thickness of the housing generally increases to maximum thickness at the center, shown at 166. Two sealing means, which are generally O-rings, are placed at either end of the outer peripheral of the center spring housing and are shown at 168 and 170.

The upper sleeve 172 of the overshot means 152 is rigidly secure to the center spring housing 160. In the preferred embodiment, the upper sleeve 172 is attached to the center spring housing 160 by means of a screw lock with an adjacent hex sock screw 174 and 176, respectively.

At the point of connection of the center spring housing 160 and upper sleeve 172, the center spring housing 160 rests on the power mandrel at 177. The chamber 178 defined by the annulus formed between the center housing and inner mandrel contains a helical spring 180. The spring 180 abuts the shoulder 181 of the member 162 of the center housing, and the lower shoulder 182 of the lower power mandrel 108. In the preferred embodiment, a helical type spring will be used.

Referring to Figure 6A, an upper neck 184 is defined on the top of the upper sleeve 172. The upper sleeve 172 contains a ledge 186 which rests on the lower power mandrel 108 and is slidably disposed so that the lower power mandrel 108 can move relative to upper sleeve 172. A sealing means, disposed in grooves 188 of the upper sleeve leg, generally consists of an O-ring 190.

As mentioned previously, the adapter 102 is threadedly connected to a release sub 200. The purpose of the release sub 200 is to allow a point in the workstring wherein if any of the downhole devices become lodged in the wellbore, and it is necessary to pull out the hole, the point where the workstring will be severed will be at the release sub 200. This prevents the entire workstring from becoming lodged, or stuck, in the wellbore.

Therefore, the outer sleeve member 154, containing ratchet teeth 156, center spring housing 160 rigidly connected to the outer sleeve members 154, an upper sleeve housing 172, and a spring 180 contained in the spring chamber 178 defined therein, comprise the overshot means.

Operation

Referring to Figure 7, in order to retrieve the downhole device utilizing the present invention, the apparatus is run into the wellbore on either coiled tubing, wireline or electric line. As means of connection from the workstring 206 utilized (coiled tubing, wireline or electric line) to the apparatus of the present invention, there is utilized a jar 204, such as a Big John jar, commonly used and appreciated by those skilled in the art. Next, threadedly connected thereto, will be a swivel 202, which will allow a fixed point at one end and a rotational point at its opposite end. In other words, the swivel allows everything beneath it to rotate, relative to the workstring employed. Again, the swivel is common in the art and known to those of ordinary skill in that art.

A third member, commonly referred to as an emergency release shear sub 200, is connected to the swivel 202. The release sub 200 is pinned at its upper end to the swivel and then threadedly connected to the power mandrel 100. The shear release sub 200 is placed in the workstring in case the workstring below the shear release sub becomes stuck, allowing for the shear sub to act as a weak point to be separated and the remainder of the workstring to be brought out of the hole.

Thus, the apparatus, with a workstring 206 as previously described, is run in the hole to the desired depth where the downhole device 220 has been set. The ratchet teeth 156 on the outer sleeve 154 will fit over the top of the valve 222 and slide over the top of the downhole device 220. The ratchet teeth 156 will engage the reciprocal ratchet teeth 157 which are located on the top of the downhole device. Once engaged, the ratchet teeth means 156 will prevent counter clockwise rotation of the over shot means 152.

Simultaneously with the engagement of the ratchet teeth 156 with reciprocal ratchet teeth 157, the shoulder 130 on the inner sleeve mandrel, lower portion 129, will act against the valve ring sleeve 224, thereby opening the valve. It should be remembered that the outer sleeve housing mandrel 154 slides over the valve 222 and engages the ratchet teeth means 156. The ratchet teeth means 156 will abut shoulder 192 of the downhole device. Downward movement of the inner sleeve mandrel 129 will be biased, however, because of the spring 180, located in the spring cham-

ber 178.

As the shoulder at 130 opens the valve 222 of the downhole device, the lug at 132 of the inner sleeve mandrel 129 enters the J-slot member located on the valve means 222. Continued downward force on the power mandrel 100 transmits the downward force through the inner sleeve mandrel 140. As ratchet teeth means 156 and reciprocal ratchet teeth 157 abut, downward movement of outer sleeve of the overshot means 154 will stop relative to the downhole device; however, the inner sleeve mandrel 140 can continue downward longitudinal travel, moving relative to the overshot means 152. As shown in figure 6C, the spring 180 is in compression. Normally, the spring is expanded to the full extent of the spring chamber 178, such that the shoulder 194 of the spring housing abuts shoulder 196 of the inner sleeve mandrel.

Next, the workstring is picked up i.e. upward longitudinal force is applied on the power mandrel 100. As upward force is applied the locks 112 travel upward relative to the inner sleeve mandrel 128 until lock 112 encounters chamfered shoulder 148. At this point, lock 112 will engage shoulder 148 which will import the upward force exerted on the power mandrel to also exert upward force on the inner sleeve mandrel 128 i.e. the power mandrel and the inner sleeve mandrel will now move upwards together.

As the power mandrel and inner sleeve mandrel continue their upward movement, the inner sleeve mandrel lug 132 will also move up in the J-slot member of the downhole device 220. Referring to Figure 6A, the power mandrel lug 118 is at a lower position in the J-slot member 142. With reference to the inner sleeve mandrel, once the lug 132 travels to the top portion of the J-slot member, the lug 132 will act against J-slot member and the locking dogs 112 will slip out of the recessed shoulder 144.

Referring to Figure 3, once locking dogs 112 has slipped out of recess neck 144, the power mandrel lug 118 travels up to point 301. As upward longitudinal force is continued to be applied to power mandrel, the lug 118 will follow J-slot member contour. Thus, lug 118 will move to the top of J-slot member 302. This traversal causes the inner sleeve mandrel to rotate. Once at the top, the lug 118 will act against the J-slot member at 302. The operator of the workstring can recognize the position of the lug relative to the J-slot member due to the increase in the weight of the workstring. Next, weight can be slacked off and lug II8 moves down relative to the J-slot member.

Lug II8 will contact shoulder 304 in its downward movement. As the workstring is slacked off (longitudinal movement downward) lug II8 will travel to 306. This traversal causes the inner sleeve mandrel to again rotate.

Thus, as the inner sleeve mandrel I28 was rotating due to the longitudinal movement of the power mandrel I00, the lug at I32 on the inner sleeve mandrel was also rotating. The rotation of the lug I32 engaged the J-slot member contained in the valve means 222 of the downhole device. An upward force, applied to the power mandrel I00 will now cause lug I32 to act against the J-slot member in the valve, and increased longitudinal movement will thereby effect a release of a downhole device 220 (Express Bridge Plug).

Figure 5 is provided to show the prior art means to retrieve the typical downhole device (bridge plug) with a rigid workstring, as shown in Figures 2A-2D. For a detailed disclosure, see the aforementioned U.S. patents.

Claims

1. Apparatus for use on a non-rigid workstring for retrieving a downhole tool, comprising a jar (204); a swivel (202) threadedly connected to said jar (204); a safety release sub (200) threadedly connected to said swivel (202), containing at least one shear pin; a power mandrel (I00) threadedly connected to said safety release sub; means (I28,I40,I29,I32,I42,I34,I36), adapted to said power mandrel (I00), for latching said apparatus to said downhole tool; and overshot means (I52) cooperating with said power mandrel, for guiding said apparatus over said downhole tool.

2. Apparatus according to claim 1, wherein said power mandrel (I00) comprises a lower power mandrel (I08) having a portion defining a plurality of grooves (II0) and a second single slotted indentation (II6) defined on said lower power mandrel (I08).

3. Apparatus according to claim 2, further comprising a plurality of locking dogs (II2), said locking dogs being received within said plurality of grooves (II0); and a first J-slot lug (II8) positioned within the single slotted indentation (II6).

4. Apparatus according to claim 1,2 or 3, wherein said means for latching comprises an inner sleeve mandrel (I28) having a first and second end, said inner sleeve mandrel being slidably disposed within said power mandrel (I00), said inner sleeve mandrel including: a first shoulder (I30) defined at the first end, a second J-slot lug (I32) disposed on said inner sleeve mandrel, a second shoulder (I36) disposed on the inside peripheral of said inner sleeve mandrel, and a recessed neck (I44) defined at the second end of said inner sleeve mandrel; the inner sleeve mandrel being rotatable relative to said power mandrel.

5. Apparatus according to claim 4, wherein said overshot means comprises a lower housing (I54),

with a first end and second end, said lower housing containing ratchet teeth (I56) to engage reciprocal ratchet teeth (I57) located on said downhole tool, said ratchet teeth being oriented in a clockwise direction to prevent counter clockwise rotation of said lower housing once said ratchet teeth of the tool have engaged with the reciprocal ratchet teeth of said downhole tool; a helical spring (I80) disposed about said inner sleeve mandrel (I28); a center spring housing (I60) securely connected to said lower housing (I54), and slidably disposed about said inner sleeve mandrel, forming a spring chamber (I78) wherein said helical spring (I80) is disposed and an upper housing (I72) having a first end and second end, said upper housing being securely connected to said center spring housing (I60) and slidably disposed about said power mandrel (I00), said upper housing containing an elastomeric member (I90) about the upper end, and a recessed neck (I84) defining a shoulder on the second end wherein said first J-slot lug (II8) will abut.

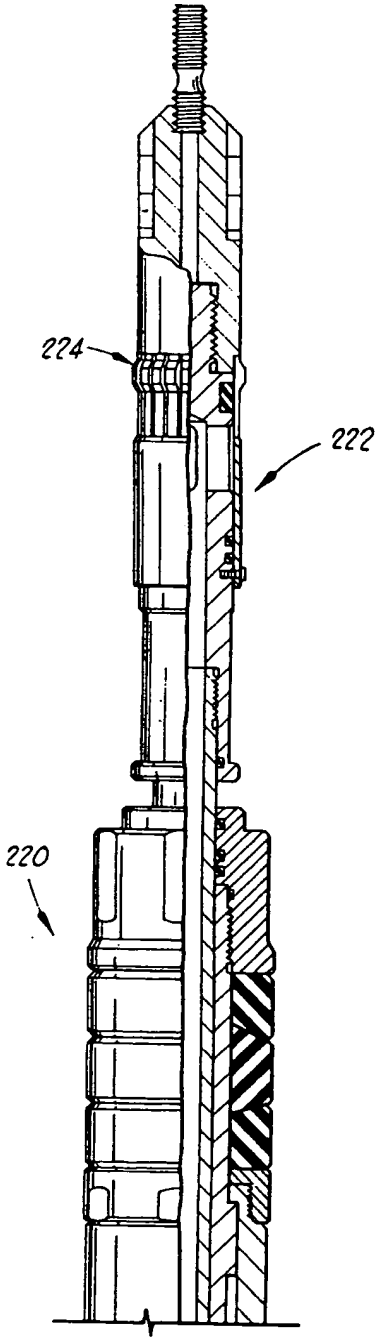

FIG. 1A
PRIOR ART

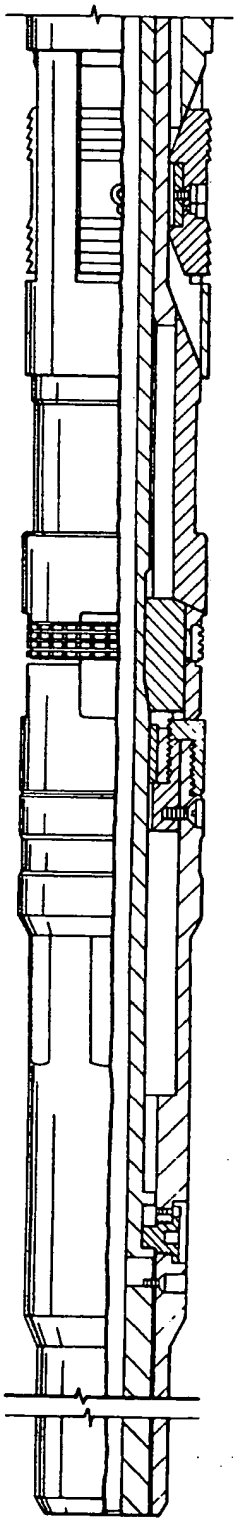

FIG. 1B
PRIOR ART

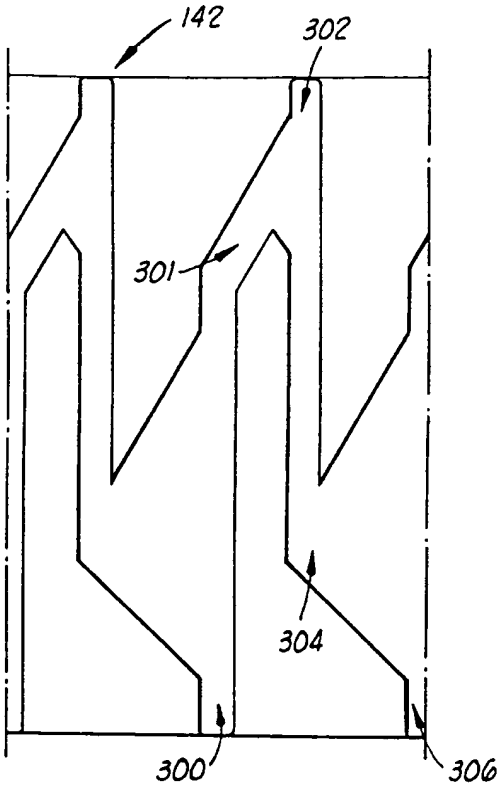

FIG. 3

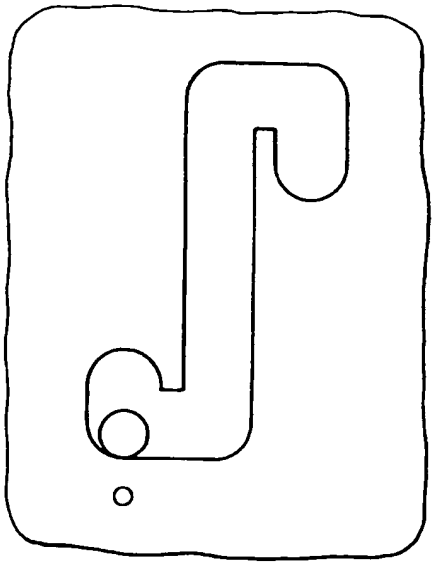

FIG. 4

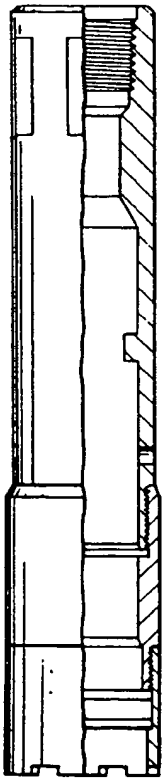

FIG. 5
PRIOR ART

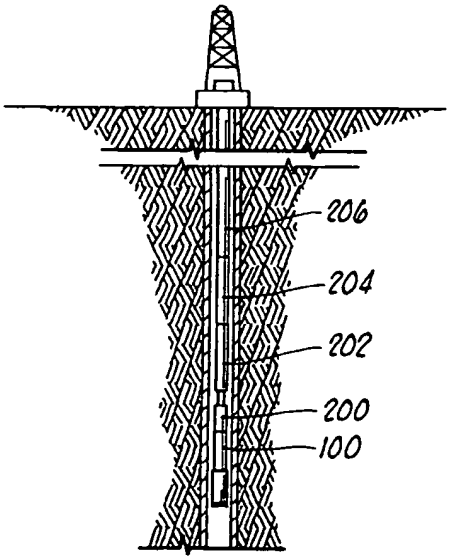

FIG. 2

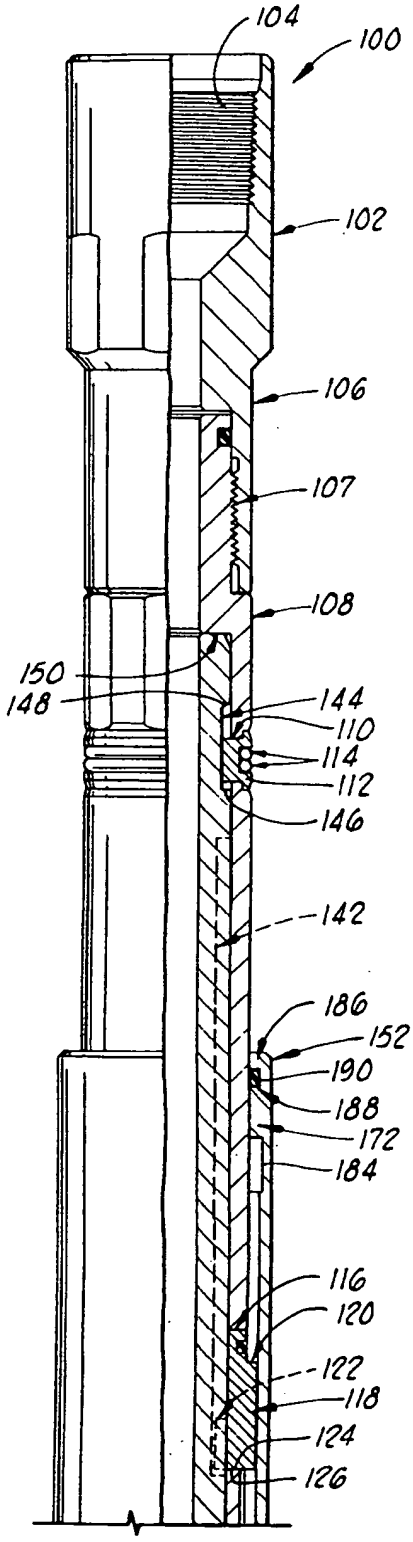

FIG. 6A

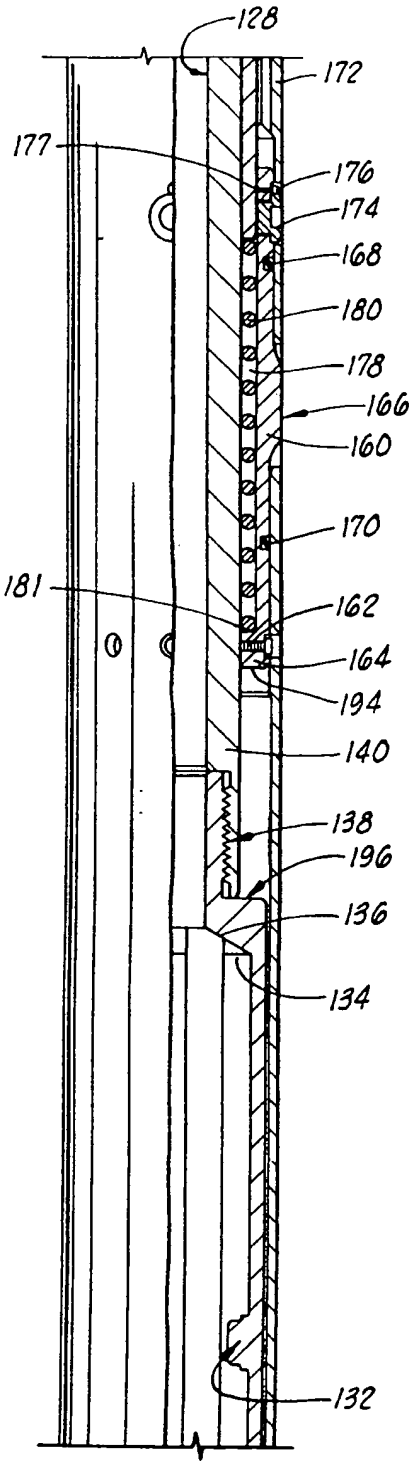
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FIG. 6B

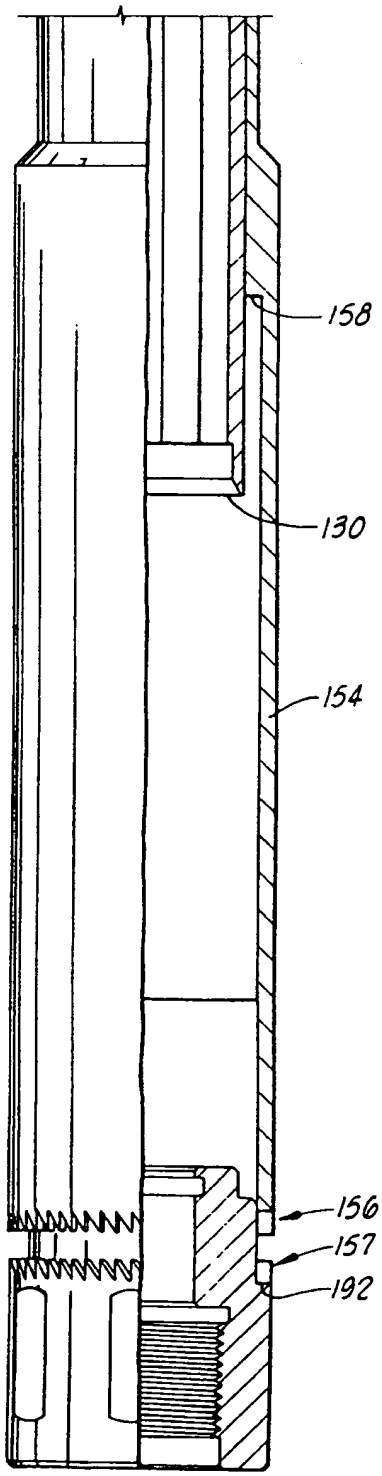
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FIG. 6C